EVALUATION OF AIR EMISSIONS FROM THE CROW LANE LANDFILL

Massachusetts Department
of
Environmental Protection

Prepared for Presentation to Public Meeting, Town of Newburyport, MA, September 14, 2006

Evaluation of Air Emissions From the Crow Lane

Residents & City

- What's in the landfill gas?
- How is it impacting us?

Evaluation of Air Emissions From the Crow Lane

- Identify the constituents of the landfill gas
- Evaluate the potential impacts of the emissions on sensitive off-site receptors
- Support MassDEP position that continuous pre-treatment to remove sulfur compounds is necessary

Evaluation of Air Emissions From the Crow Lane

- Phase I – Sampling
- Phase II – Dispersion Modeling
- Phase III – “Risk” Evaluation

Evaluation of Air Emissions From the Crow Lane

Phase I – Sampling

- **Landfill Gas Characterization**
  - Landfill Gas Extraction System
  - Ambient Air Samples

Evaluation of Air Emissions From the Crow Lane

Phase I – Sampling

- **Analytical Parameters**
  - Sulfide Compounds
  - Volatile Organic Compounds
  - Arsine Gas
  - Mercury Vapor
- **System Operating Parameters**

Evaluation of Air Emissions From the Crow Lane

Phase II – Dispersion Modeling

- Model Concentrations at Receptors
- EPA Accepted Models
- Model Input/Output - Conservative

Evaluation of Air Emissions From the Crow Lane

Phase II – Dispersion Modeling

- Screening Model
- Refined Model

Evaluation of Air Emissions From the Crow Lane

Phase III – Evaluation of Landfill Gas Emission Data

EVALUATION OF LANDFILL EMISSIONS DATA FOR CROW LANE LANDFILL

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Components of Evaluation of Landfill Gas Emissions

(1) Monitored Ambient Air

- Charmanski Dr.
- 2 days
- H_2S
- Every 5 min.
- Worst case – raw landfill gas

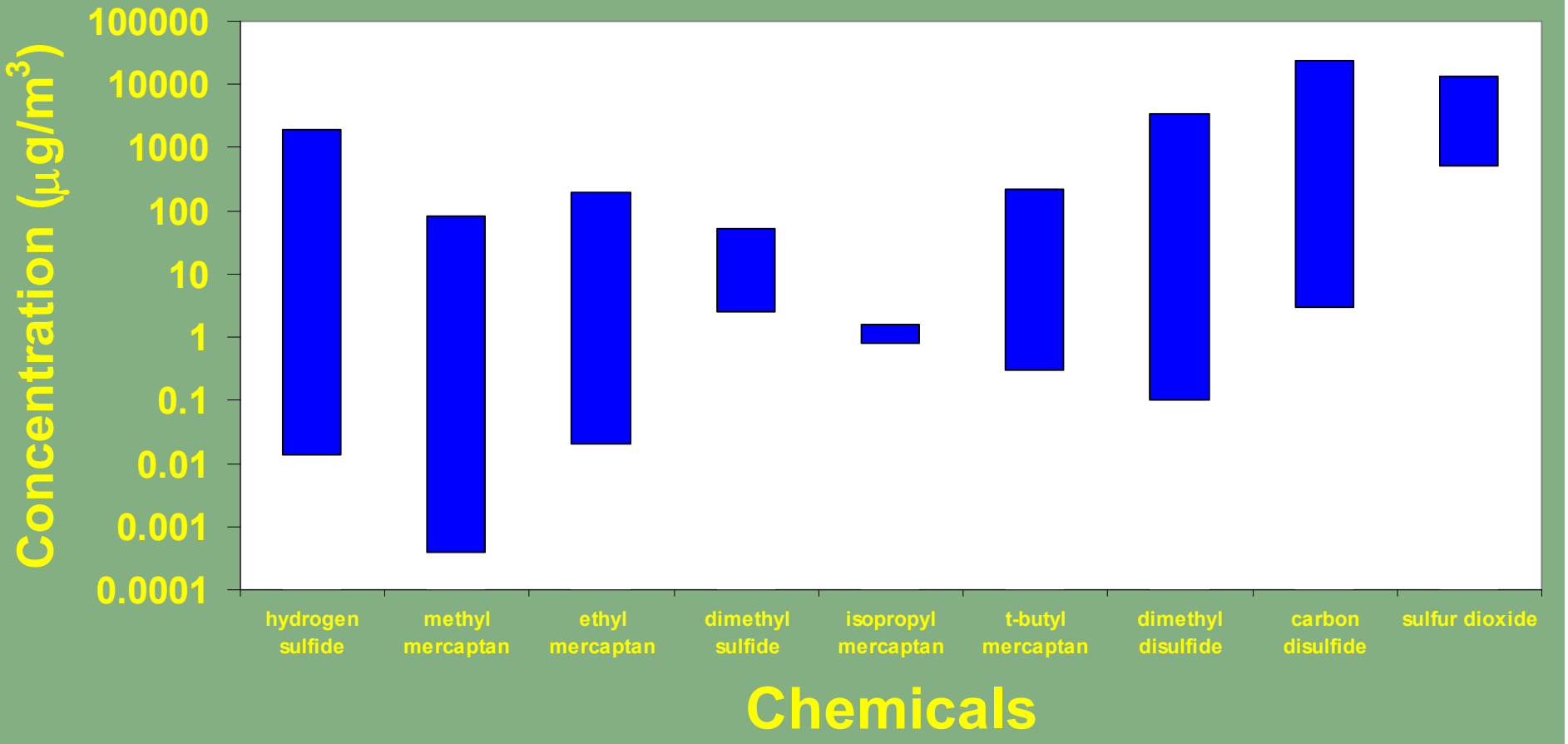
(2) Monitored Ambient Air

- Charmanski Dr.
- 2 months
- H_2S
- Every 5 min.
- High flow rate, flare, propane

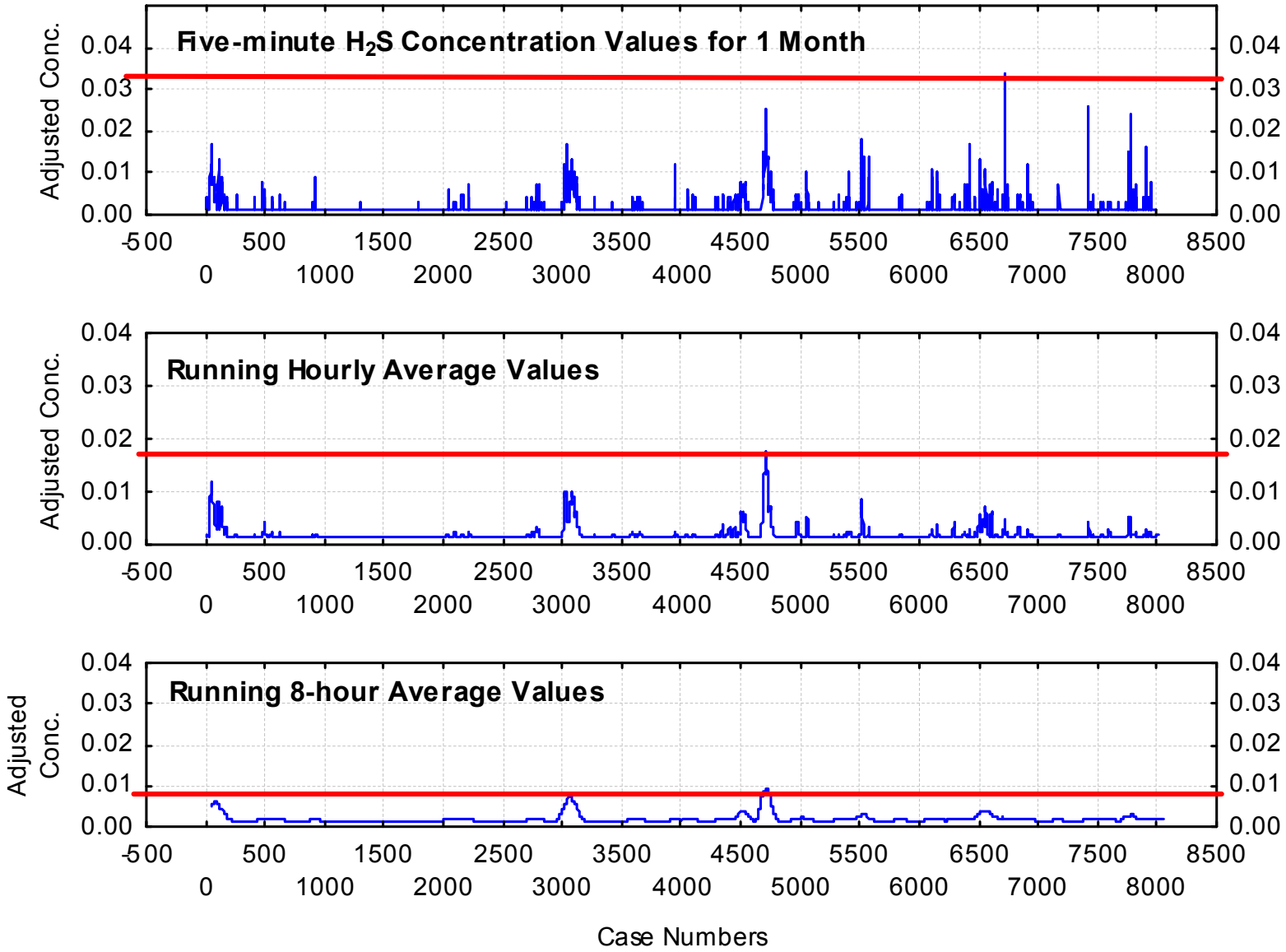
(3) Modeled Ambient Air

- 19 locations
- 2 years
- H_2S, SO_2 and other S-cmpds, VOCs
- Hourly
- Multiple operating conditions

Ranges of Odor Thresholds for S-Chemicals



Effect of Averaging Period H_2S on Concentration Profile



Analysis of August Monitoring Data

- Screened with odor threshold value of 11 ug/m^3
- Identified periods when concentrations > instrument detection limit of ~1.4 – 2.8 ug/m^3 (1-2 ppb) for > ~30 minutes occurred
- Calculated running 30 and 60-minute average concentrations

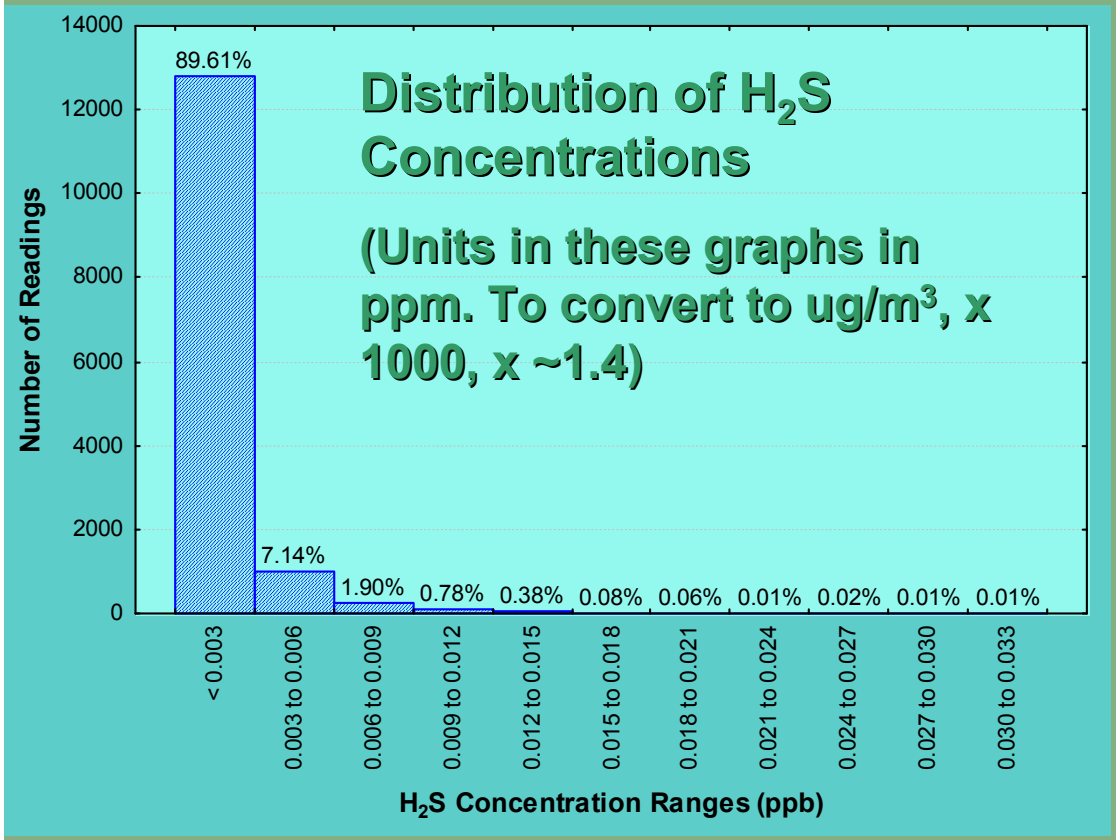
What We Learned from Worst Case in August

- Concentrations of H_2S >> odor Threshold occurred in 14% of measurement intervals
- Events lasted from ~1 – 9 hr when concentrations were > LOD
- Concentrations exceeded California's 1-hour H_2S guideline of 42 ug/m^3 for almost 6 hours of the 2-day monitoring period
- Neighbors complained of symptoms consistent with the levels of H_2S exposures.

Analysis of Nov. – Dec. Monitoring Data

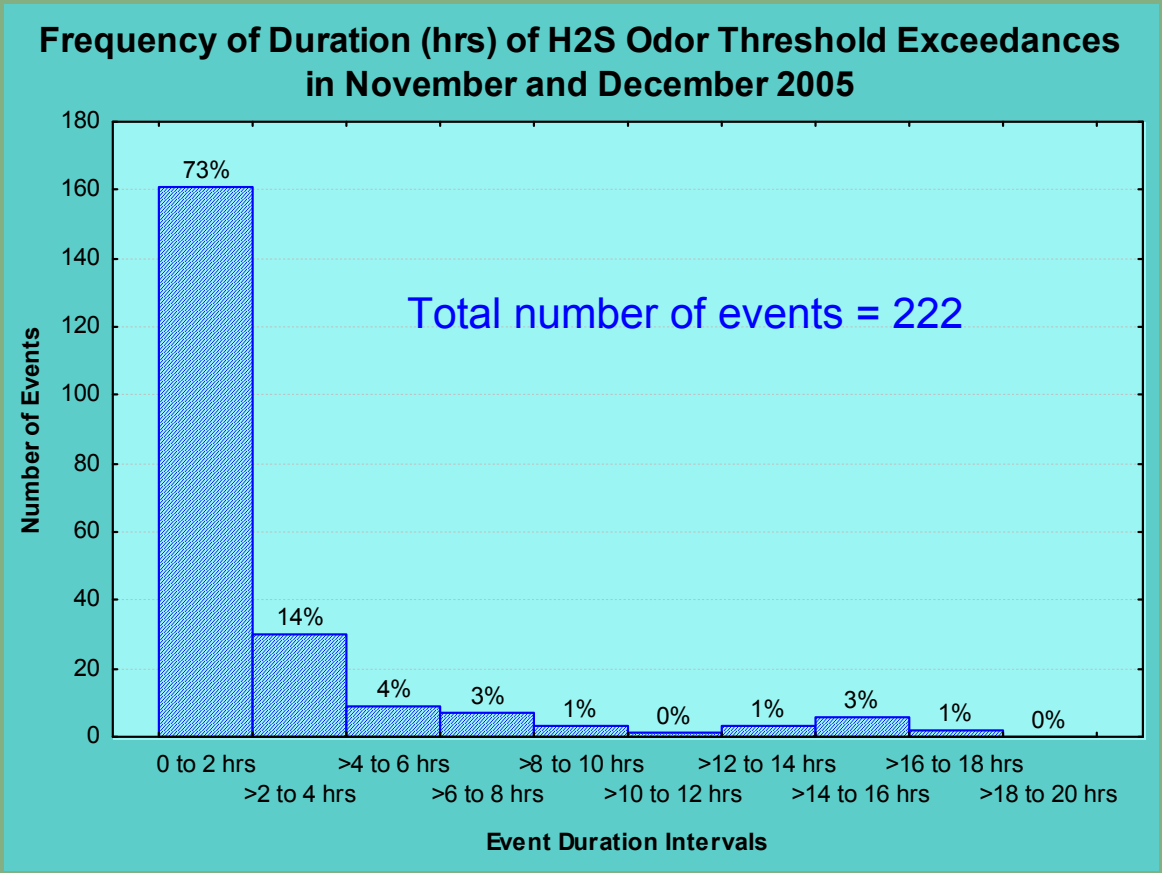
- 5 - minute readings
- Used odor threshold of 0.7 ug/m^3 for H_2S
- Calculated running 30-minute averages
- Identified periods > 10 min. duration when concs. > odor threshold (i.e., any positive instrument reading)
- Compiled frequency histogram of # times events > odor threshold occurred for different durations
- Compared timing of receipt of odor complaints to record of H_2S concs.

What We Learned from Nov/Dec Monitoring Data



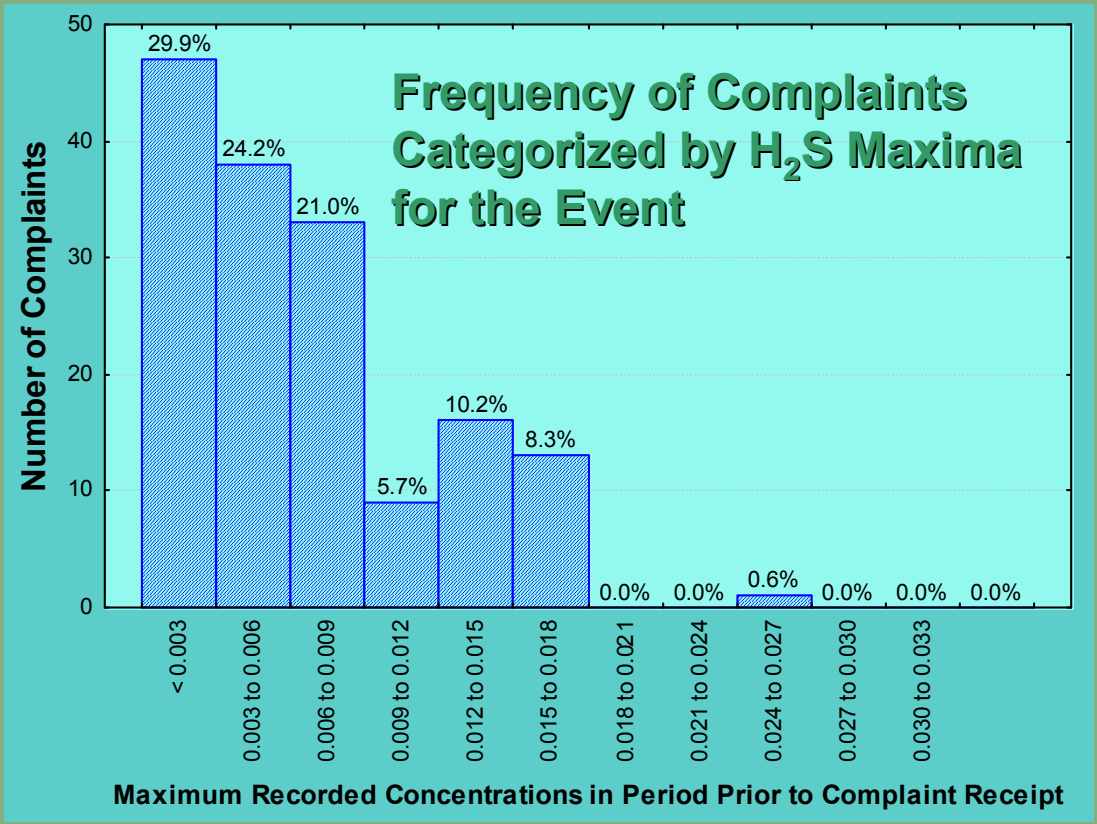
- 5- min. H_2S concs. ranged from 2 – 47 ug/m³
- 89% of 5-minute readings were < Detection limit (~ 4 ug/m³)
- 30–minute running average values were NEVER > health-based guidelines

What We Learned from Nov/Dec Monitoring Data



- **222 separate events longer than ~ 10 minutes when concentrations > odor threshold**

What We Learned from Nov/Dec Monitoring Data



- Citizen complaints (158) coincided with detection of H_2S by instrument

Modeling

A. Model Methods

- Analyzed dispersion of 11 S-compounds & VOCs
- Predict ambient air levels of landfill chemicals at 19 locations on hourly basis for 2 years & output maximum hourly values at each location for each operating condition
- Presented as different averaging periods:

1,3,8,24 hours, **annual**

- Modeled 6 cases


Breenahan School
Belleville School
Currier School
K-Mart
Merrimac Place
Low St. @ Murphy St.
Senior Center
Anna Jaques Hospital
Davenport School
Day Care Center
Newburyport H.S.
3 Chamberlaid Drive (Monitor)
Wildwood @ Quail Run Hollow
Knox M.S.
Elderly Housing
Acute Care/ Rehab Facility
End of Doe Run
Hale St. @ Squires Run
3 Doe Run Drive
Locus Map
Maine
New Hampshire
Massachusetts
Legend
Flare Location
Sensitive Receptors
Hospital
Massachusetts DEP
Crow Lane Landfill
Newburyport, MA
Locations of Sensitive Receptors
ENSR | AECOM
Scale 0 0.25 0.5 0.75 1 Miles

Operating Conditions Modeled

Case	Location of Open Flare	Flow Rate(cfm)	With or Without Supplemental Propane
Case 1A	**Current Location**	**23**	**Without**
Case 1B	Current Location	23	With
Case 2A	Current Location	130	Without
Case 2B	**Current Location**	**130**	**With**
Case $2A_{Top}$	Top of the Landfill	130	Without
Case $2B_{Top}$	Top of the Landfill	130	With

Data Evaluation Methods

1) ID Health-based Exposure guidelines
2) Compare predicted maximum concentrations to guideline limits:
3) Hazard Index (HI) = $\frac{\text{concentration}}{\text{guideline}}$
4) Add HI across all chemicals at a location to give a total HI
5) Compare both to a cutoff of 1.

Data Processing Example

CONCENTRATIONS

Compound	Anna Jacque	New burypor	Davenport S	Currier Scho
Hydrogen Sulfide	1.13E+02	9.53E+01	7.03E+01	7.73E+01
Carbonyl Sulfide	1.70E+01	1.44E+01	1.06E+01	1.16E+01
Methyl Mercaptan	2.10E+00	1.77E+00	1.31E+00	1.44E+00
Ethyl mercaptan	3.72E+00	3.14E+00	2.31E+00	2.55E+00
Dimethyl Sulfide	7.66E+00	6.46E+00	4.76E+00	5.24E+00
Isopropyl mercaptar	3.64E+00	3.07E+00	2.26E+00	2.49E+00
t-butyl mercaptan	3.58E+00	3.01E+00	2.22E+00	2.45E+00
Ethyl methyl sulfide	3.76E+00	3.17E+00	2.34E+00	2.57E+00
Dimethyl Disulfide	4.65E+00	3.92E+00	2.89E+00	3.18E+00
carbon disulfide	6.15E-05	5.18E-05	3.82E-05	4.20E-05

Hazard Indices

Chemicals	Acute Tox Values	Anna Jacques Hospital	Newburyport High School	Davenport School	Currier School	Belleville School
hydrogen sulfide	42	2.7E+00	2.3E+00	1.7E+00	1.8E+00	1.4E+00
carbonyl sulfide	42	4.1E-01	3.4E-01	2.5E-01	2.8E-01	2.1E-01
methyl mercaptan	3	7.0E-01	5.9E-01	4.4E-01	4.8E-01	3.6E-01
ethyl mercaptan	850	4.4E-03	3.7E-03	2.7E-03	3.0E-03	2.3E-03
dimethyl sufide	420	1.8E-02	1.5E-02	1.1E-02	1.2E-02	9.5E-03
isopropyl mercapta	850	4.3E-03	3.6E-03	2.7E-03	2.9E-03	2.2E-03
t-butyl mercaptan	850	4.2E-03	3.5E-03	2.6E-03	2.9E-03	2.2E-03
ethyl methyl sulfide	420	8.95E-03	7.55E-03	5.56E-03	6.12E-03	4.66E-03
dimethyl disulfide	13	3.6E-01	3.0E-01	2.2E-01	2.4E-01	1.9E-01
carbon disulfide	4100	1.5E-08	1.3E-08	9.3E-09	1.0E-08	7.8E-09
sulfur dioxide	660	1.9E+00	1.6E+00	1.2E+00	1.3E+00	1.0E+00
# of exceedances:		2	2	2	2	1
total HI:		**6.1E+00**	**5.2E+00**	**3.8E+00**	**4.2E+00**	**3.2E+00**

Data Processing Continued

- **For cases where HI > 1, ask:**

  "How often did it occur?"

- **Count # times the 1-hour concentration was > guideline at the location and divide by total # hours modeled → Frequency**

  Chose for further analysis:
  - Case 1A (low flow without supplemental propane);
  - Case 2B (higher flow rate with supplemental propane)

Health-based Exposure Limits – VOCs

- Employed longer-term (subchronic and chronic) toxicity guidelines (very conservative for comparison with shorter-term average concentrations)
- All predicted concentrations for all averaging periods were <<< toxicity guidance for all chemicals
- No further analysis – No Health Risks of Concern (for both cancer and non-cancer effects

Health-based Exposure Limits – Sulfur Compounds

Chemical	One-Hour Average ($\mu g/m^3$)	Annual Average* ($\mu g/m^3$)
Hydrogen sulfide	42	20
Carbonyl sulfide	42	20
Methyl mercaptan	3	1
Ethyl mercaptan	850	1
Dimethyl sulfide	420	11
Isopropyl mercaptan	850	1
t-Butyl mercaptan	850	1
Ethyl methyl sulfide	420	11
Dimethyl disulfide	13	11
Carbon Disulfide	4100	700
Sulfur Dioxide	660	80

Results

- Only chemicals with concentrations > guideline limits were: H_2S, COS, SO_2
- Risks associated with acute 1 hour exposures are of most concern – also affects greatest # of locations
- None of 24-hour average concentrations or annual average concentrations for SO_2 were greater than the NAAQS for SO_2
- No chemical concentrations is > subchronic toxicity value (HI 0.12 – 1)

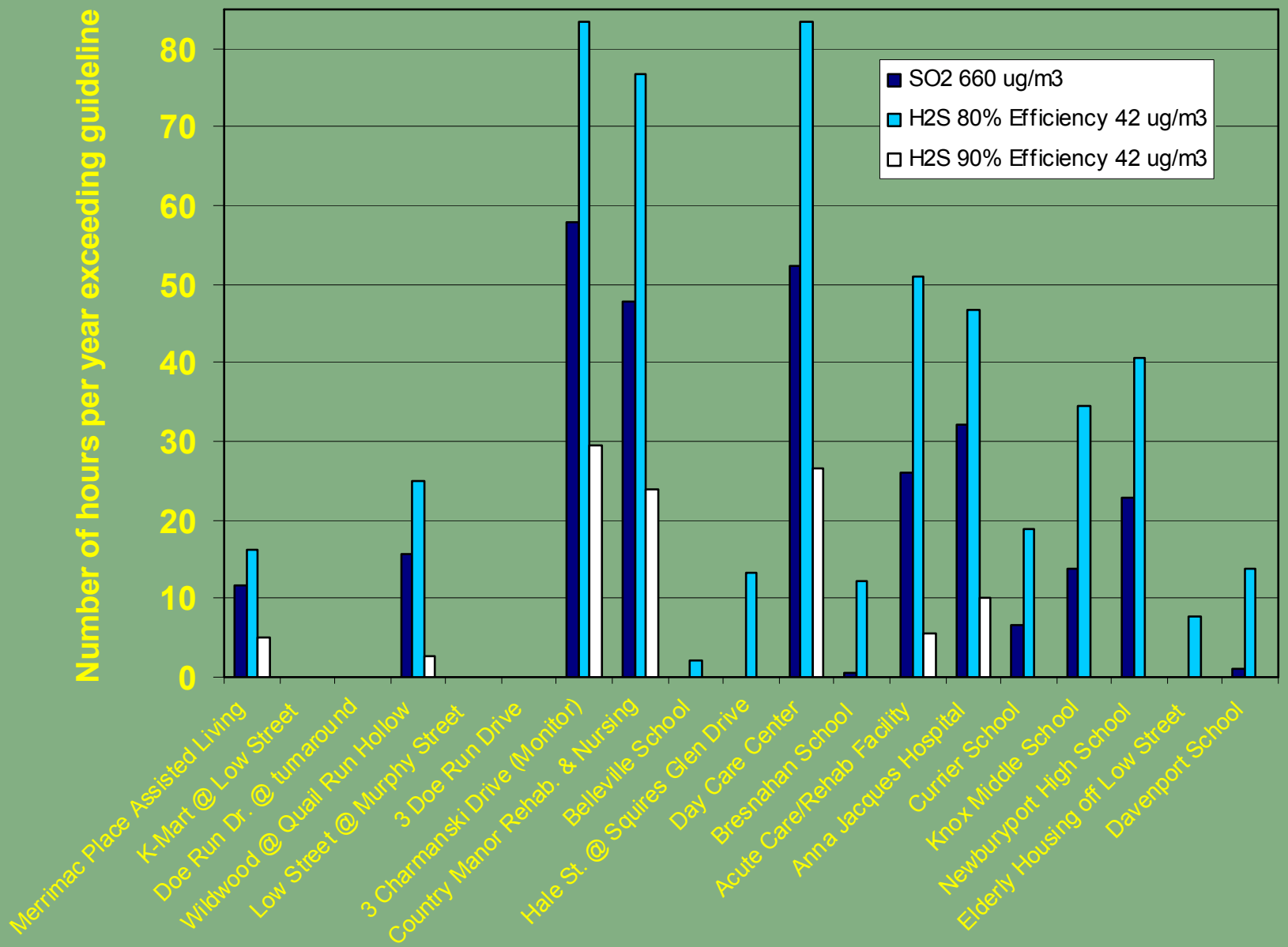
--- NO LONG-TERM HAZARD

Results – Scale and Magnitude of Risks

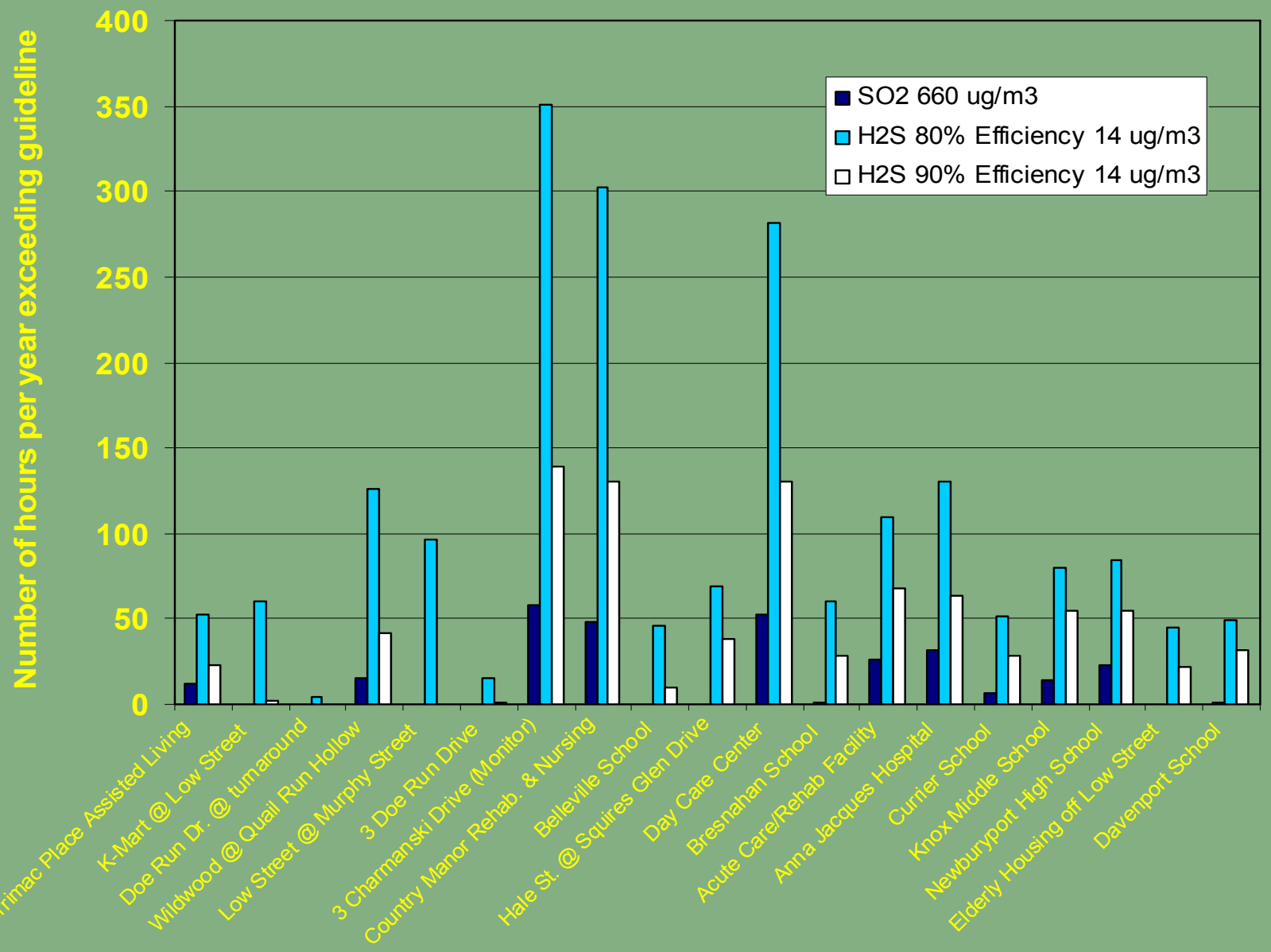
Chemicals Exceeding Guideline	Exposure Limit Used, ug/m^3	# Locations Where the Chemical Guideline is Exceeded (19 total locations)	Range of Chemical HIs Associated w/Exceeded Guideline
Case 1A			
H_2S	42 14	3 19	1.2 – 1.3 1.1 – 3.8
CASE 2B			
H_2S	42 14	15 19	1.2 – 3.1 1.2 – 9.4
SO_2	42 14	12 12	1.0 – 2.2 1.0 – 2.2
COS	14	6	1.1 – 1.4

for 80% flare destruction efficiency

Projected Frequency of Exceeding H_2S Guideline of 42 ug/m^3 and SO_2 Guideline of 660 ug/m^3



Projected Frequency of Exceeding H_2S Guideline of 14 ug/m^3 and SO_2 Guideline of 660 ug/m^3



Conclusions

- Modeled concentrations were higher under those scenarios that assumed the open flare would remain in its current location.
- Concentrations were lower in those cases that assumed the open flare would be moved to the top of the hill.
- Modeled concentrations based on a flow rate of 130 cfm were higher than concentrations modeled at 23 cfm.
- Modeled concentrations were lower in cases that assumed the addition of supplemental propane.

Conclusions

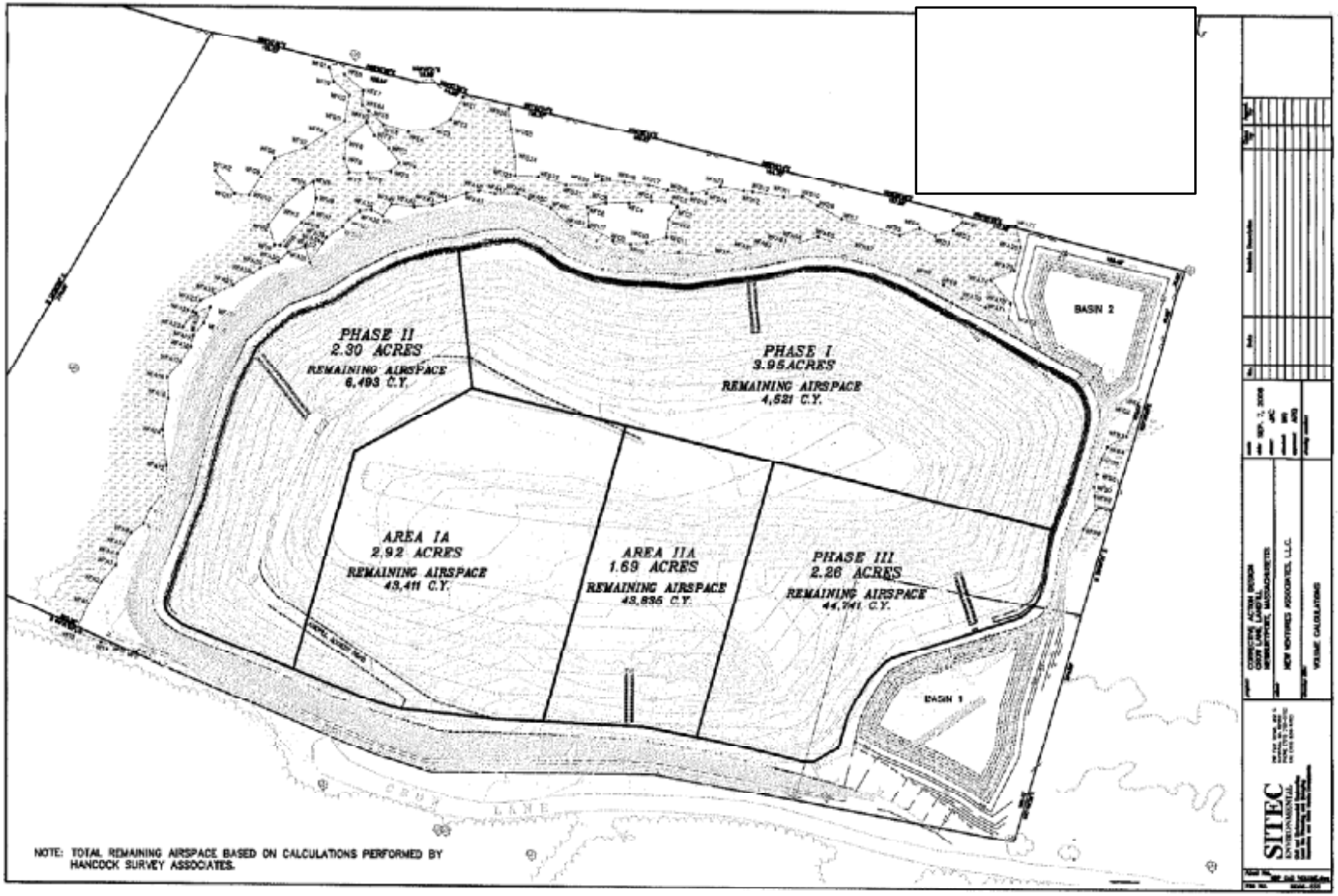
- The highest modeled concentrations were determined for Case 2A, in which the open flare is maintained in its current location, with the higher flow rate of 130 cfm with no supplemental propane.
- The lowest modeled concentrations were determined for the top of the landfill hill scenario with supplemental propane.
- The rest of the cases were characterized by concentrations intermediate between these two extremes.

Conclusions

- Predicted concentrations have potential to produce adverse health effects under a range of flow rates at the present flare location;
- SO_2 concentrations will exceed its guideline more often as flow rate increases;

Conclusions

- Model results consistent with measured data from 2005:
- Concentrations greater than odor and health limit in August
- Greater than odor threshold in Nov/Dec and highest concentrations between health thresholds of 14 and 42 ug/m^3


PHASE II
2.30 ACRES
REMAINING AIRSPACE
6,493 C.Y.
PHASE I
2.95 ACRES
REMAINING AIRSPACE
4,521 C.Y.
BASIN 2
AREA IA
2.92 ACRES
REMAINING AIRSPACE
43,411 C.Y.
AREA IIA
1.69 ACRES
REMAINING AIRSPACE
43,856 C.Y.
PHASE III
2.26 ACRES
REMAINING AIRSPACE
44,741 C.Y.
BASIN 1
CRUFT LANE
NOTE: TOTAL REMAINING AIRSPACE BASED ON CALCULATIONS PERFORMED BY HANCOCK SURVEY ASSOCIATES.
CORRECTIVE ACTION DESIGN
CRUFT LANE LANDFILL
WEBSTER, MASSACHUSETTS
NEW ENGLAND ASSOCIATES, L.L.C.
VOLUME CALCULATIONS
SITEC
ENVIRONMENTAL